Specific edge effects in highly endangered Swartland Shale Renosterveld in the Cape Region

Effets de lisières spécifiques dans les Swartland Shale Renosterveld, *formation arbustive en voie de disparition de la région du Cap en Afrique du Sud*

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Abstract

The critically endangered Renosterveld shrubland of the Cape Floristic Region in South Africa is one of the most transformed vegetation types in the world. The mostly small patches that remain after the extensive fragmentation are potentially vulnerable to edge effects and therefore, information on the extent of edge effects in this vegetation type is urgently required for conservation planning. To provide this information, we studied edge effects at two sites in each of five larger fragments of Swartland Shale Renosterveld near Cape Town surveying the vegetation composition along three 10 m wide and 200 m long belt transects. There was little indication of edge effects among the dominant woody species. However, abundance and/or species richness of the petaloid monocotyledonous plants, which contribute a disproportionally high fraction of the vegetation type's high biodiversity, as well as the ferns, had a clear negative correlation with edge proximity. For these taxa, effects did not level off at the end of the transect at 200 m. This extent of impact is much larger than those reported in most other studies on edge effects among plants. In contrast, species indicative of high disturbance levels generally decreased within the first 30 m. Consequently, Swartland Shale Renosterveld fragments would be likely to benefit from being enlarged to over 400 m width, while corridors or stepping stones should have a width of over 60 m to minimize major edge effects.

Keywords: Fragmentation, geophytes, mediterranean-type shrubland, petaloid monocotyledonous plants, reserve size and shape.

Introduction

Edge effects are a generally well researched phenomenon (Saunders *et al.* 1991) and can have large scale detrimental impacts. Average reported values for depth of edge influence are 60 m for abiotic factors (Harrison & Bruna 1999; Matlack 1993), 50 m for plants, 100 m for invertebrates and 50 to 200 m for birds (reviewed by Ries *et al.* 2004). Physical factors are claimed to be the predominant cause for the negative effects that fragmentation has on biodiversity (Harrison & Bruna 1999). Edge effects have been intensely researched in temperate and tropical forests (Murcia 1995), but to date very little has been published on vegetation responses in mediterranean-type shrublands with the notable exception of the study by Hester and Hobbs (1992), who found indistinct edge effects on native annual plants in shrublands in the Western Australian wheat-belt reaching up to 60 m into the fragment.

South African West Coast Lowland Renosterveld, a shrubland vegetation type within the highly diverse Cape Floristic Region, has been intensively transformed within the past 300 years, reduced to between 3% and 9.4% of its original extent (depending on the study and definition of vegetation type) and split into a large number of small fragments (Low & Rebelo 1996; McDowell & Moll 1992; Newton & Knight 2005; von Hase *et al.* 2003). Therefore, edge effects are likely to impact on much of the remaining habitat, but so far have only been studied in two unpublished M. Sc. theses (De Villiers *et al.* 2003; Muhl 2008) focusing on the effects of alien grass invasion.

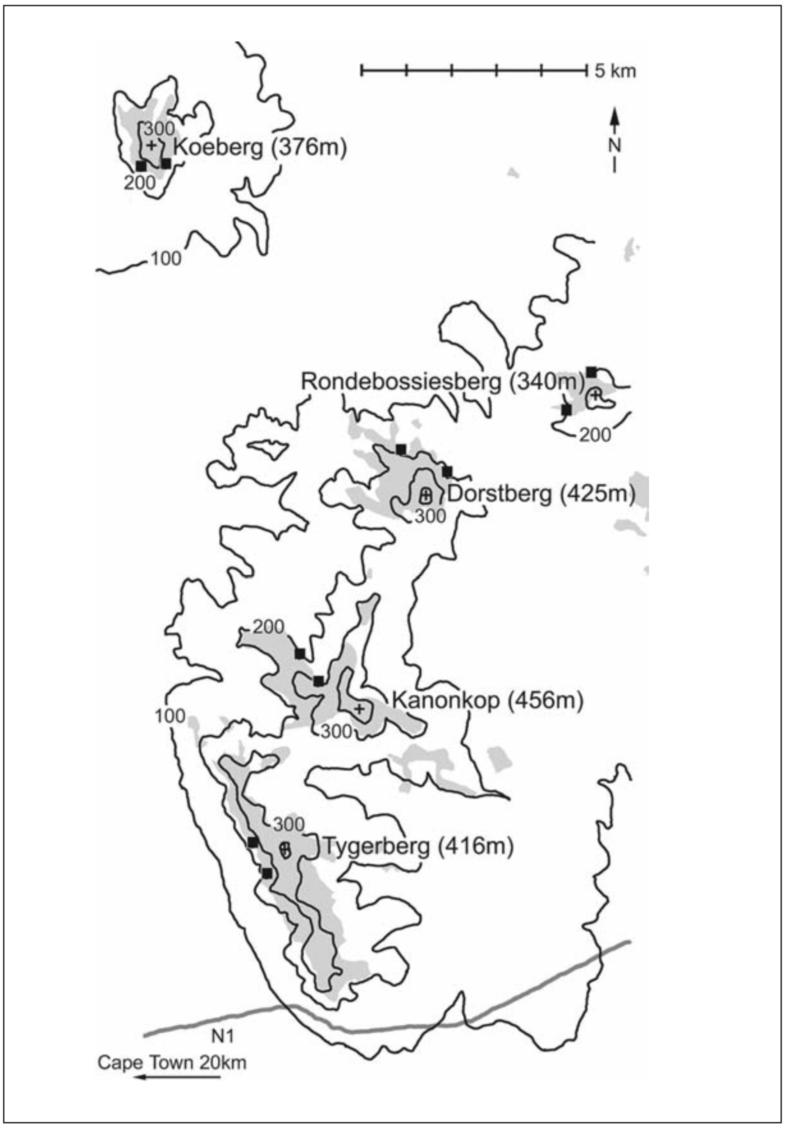

Figure 1 – Study area with extent of Renosterveld (shaded in grey) and sampling sites (■).

To make recommendations for the conservation of Renosterveld, we investigated how far edge effects extended into the fragments and what plant groups and species were affected. This information was then used to suggest a minimum width for fragments to receive the highest conservation priority, to what size smaller fragments should be enlarged for the inclusion of core habitat, and how wide corridors and stepping stones would need to be to include non-edge dominated habitat.

Study Area

The study was conducted in the Tygerberg Hills, which lie just North-East of the Cape Town city centre in the Western Cape Province of South Africa (Figure 1). This area was chosen in the context of the Tygerberg remnants initiative (Table Mountain Fund/World Wildlife Fund) to provide information for conservation planning and because it contains some of the largest remaining fragments of West Coast Renosterveld.

Renosterveld is a vegetation type dominated by asteraceous shrubs and grasses, the prehistorical balance of which is still under debate (Krug *et al.* 2004; Low & Rebelo 1996; Rebelo 1995; Stock *et al.* 1993). Geophytes occur in high numbers and contribute disproportionally to the high local species diversity (Moll *et al.* 1984; Procheş *et al.* 2005; Ruiters 2001). The vegetation in the study area is classified as "Swartland Shale Renosterveld" by Rebelo *et al.* (2006) and described as follows: "Low to moderately tall leptophyllous shrubland of varying canopy cover dominated by [*Dicerothamnus rhinocerotis*]."

Methods

Survey design

All fragments within the study area with a minimum diameter of 500 m were selected for the survey to ensure a gradient length of 200 m. All five fragments were less than 700 m wide. Total fragment size varied from 80 ha to 600 ha. Grazing of livestock within the fragments was similar, but varied between years for all fragments. Some fragments were fenced off, whereas others were not or had fences running through the vegetation into the patch. In addition, fences had been put up at different times.

On each fragment, two sites were selected with linear edges bordering pastures or fields, with a distance to the next natural vegetation patern greater than 1 km (Fernández *et al.* 2002) and with at least 100 m between them. All selected sites had uphill gradients and a post-fire age of over 30 years. At each site, three belt-transects of 10 m width, spaced 10 m apart were surveyed. The start and end points of every woody species were recorded along line transects (running parallel to the edge) at 1 m, 2 m, 5 m, 10 m, 20 m, 50 m, 100 m and 200 m from the edge of the fragment into the centre (Figure 2). Since individuals of different species were overlapping, total distance covered could be over ten meters. In addition, the dominant species or taxa in the herb layer were noted. Among the grasses and petaloid monocotyledonous species, identification was not possible for some species that were not in flower, so for consistency all species within these taxa were categorized as "grasses" and "petaloid monocotyledons", respectively. "Petaloid monocotyledons" are defined here as monocotyledonous plants with large, showy flowers, which are mostly pollinated by animals, and are treated as consistent with monocotyledonous geophytes.

Results from the three line transects at one site with the same distance from the edge were averaged for each site to avoid pseudoreplication (Hurlbert 1984).

Analysis

All data were tested for normality with the Shapiro Wilk's W-Test and analyzed accordingly. To test for significance of edge effects, we used either a parametric ANOVA (F) or a Kruskal-Wallis ANOVA by rank (H) and Pearson correlation (r) or Spearman rank correlation (r) tests. With these tests, we analyzed only species or taxa recorded in at least 10 of all 240 linear transects for statistic validity. For species richness analyses, we used all identified species and grouped all other species into a "non-identified" category. Species numbers are therefore minimum values only.

Results

A list of all species identified to species' level showing their occurence on the transects and including their distribution area can be found in the appendices A-C. The most common woody species *Dicerothamnus* (previously *Elytropappus*) *rhinocerotis* and *Eriocephalus africanus* did not respond significantly to distance from the fragment edge; nor did the amount of bare ground (Figure 3). Only one of the woody species occurring in more than 25 plots, *Helichrysum patulum*, showed a significant increase in cover with increasing distance from the edge. However, a number of woody species occurring in 10 to 25 plots did exhibit significant trends (Spearman R $> \pm 0.25$, $p < 0.05$), *i.e. Asparagus capensis* and *Euryops thunbergii*, which increased in cover with distance from the edge, and *Athanasia trifurcata*, *Berkheya rigida*, *Leysera gnaphalodes* and *Otholobium hirtum*, which decreased with distance from the edge.

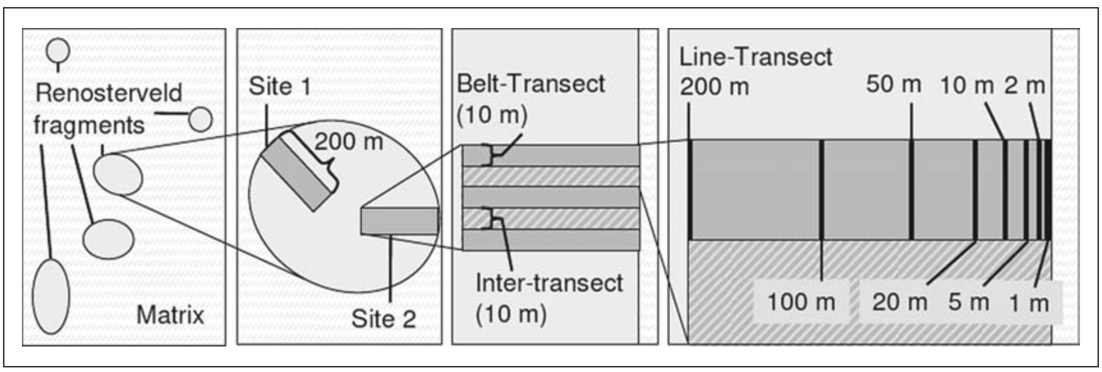

Figure 2 – Sampling design.

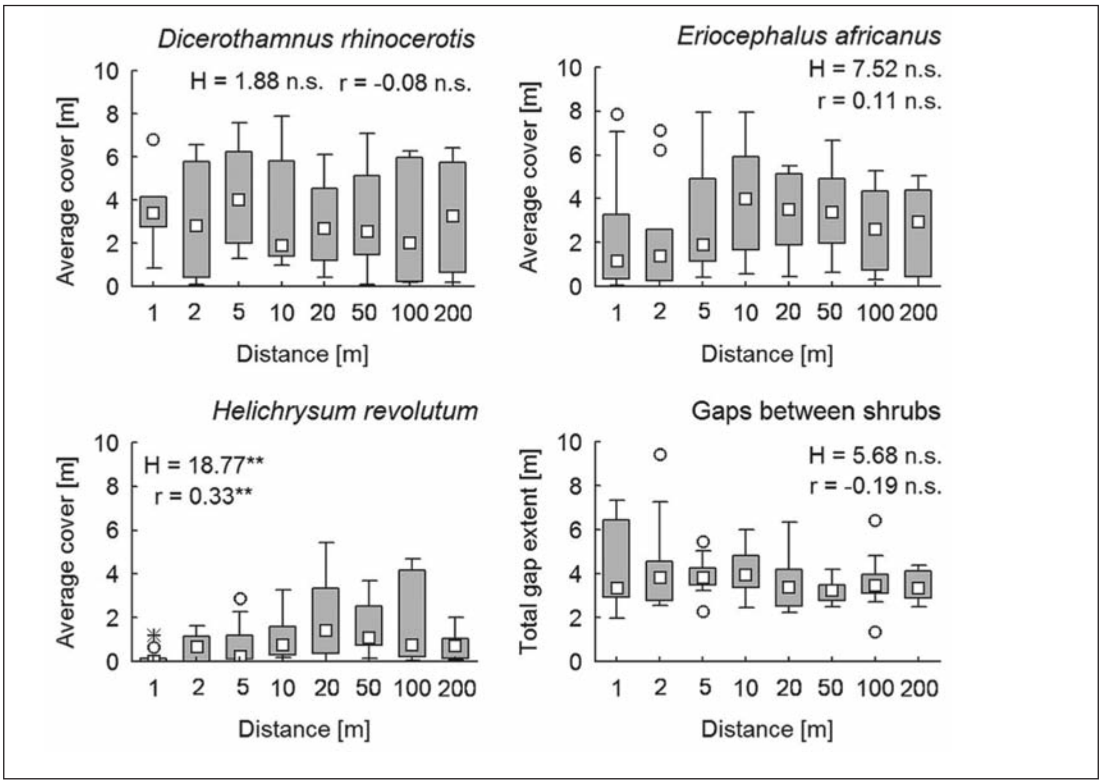

Figure 3 – Top left: Average cover of **Dicerothamnus rhinocerotis** *per line transect per site.*
Top right: Average cover of **Eriocephalus africanus** *per line transect per site.*
Bottom left: Average cover of **Helichrysum revolutum** *per line transect per site.*
Bottom right: Average total extent of gaps per line transect per site.

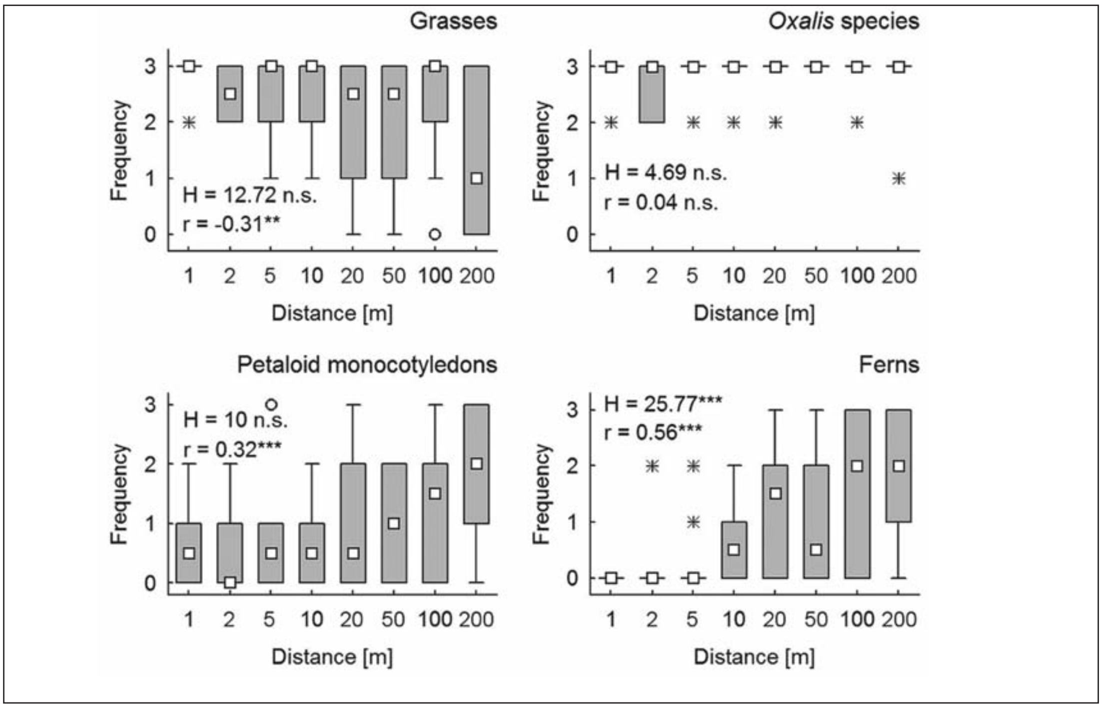

Figure 4 – Top left: Number of line transects per site that at least one grass species occurs in with at least 5 individuals.
Top right: Number of line transects per site that at least one **Oxalis** *species occurs in with at least 5 individuals.*
Bottom left: Number of line transects per site that at least one petaloid monocotyledon species occurs in with at least 5 individuals.
Bottom right: Number of line transects per site that at least one fern species occurs in with at least 5 individuals.

Among the most common non-woody taxa, the *Oxalis* spp. were the only ones not displaying a significant response to distance from the edge of the fragment (Figure 4). While grasses in general showed a significant decline towards the fragment interior, petaloid monocotyledons (see Appendix) and ferns increased significantly with increasing distance from the edge. Among the taxa occurring in between 10 and 25 plots, only three responded significantly (Spearman R $> \pm 0.29$, $p < 0.05$): *Anagallis arvensis*, an alien, and *Senecio arenarius* exhibited significant increases, while *Vicia sativa*, another alien plant, decreased significantly with distance from the edge. The other two common alien species (*Erodium moschatum* and *Fumaria muralis*) did not respond to increasing distance from the fragment edge.

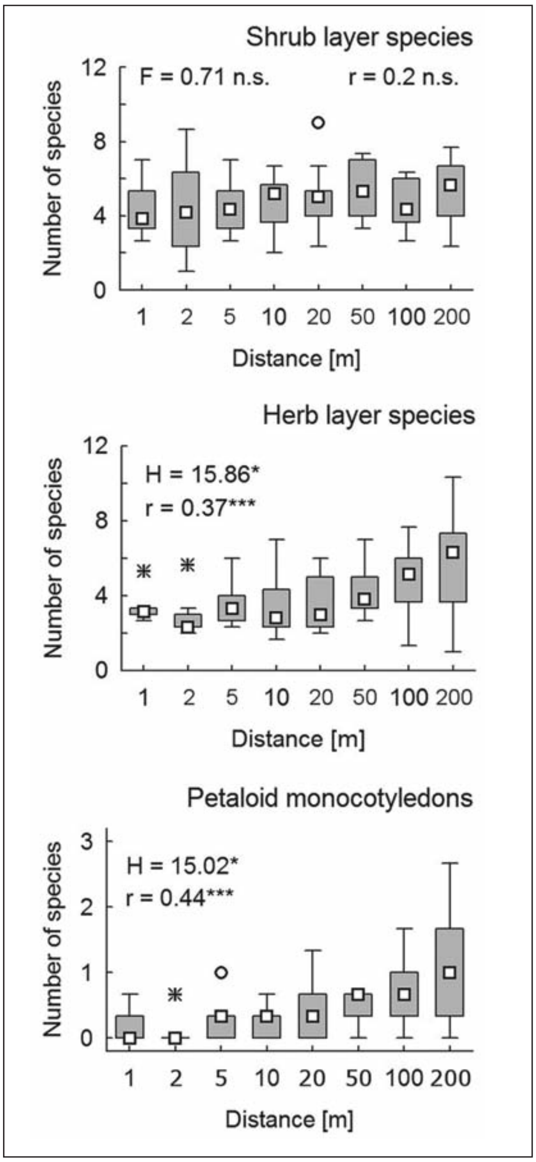

***Figure 5** – Top: Average number of shrub layer species occurring in the three linear transects at one site.*
Centre: Average number of herb layer species occurring in the three linear transects at one site with at least 5 individuals per transect.
Bottom: Average number of petaloid monocotyledon species occurring in the three linear transects at one site with at least 5 individuals per transect.

Whereas shrub layer species richness did not respond to increasing distance from the edge, species richness of all dominant herbaceous taxa in general and petaloid monocotyledons in particular showed a strong positive correlation (Figure 5).

Discussion

While dominant woody species and many common herbs did not show a clear effect of distance from the fragment edge, a number of plant taxa did; most notably, fern and petaloid monocotyledon abundance and/or species richness increased with distance and did not appear to approach saturation at the end of the transect at 200 m, so it is possible that the edge effects would be more extensive in larger fragments. With a buffer zone of 200 m, the core area in fragments over 3 ha would be reduced to only 11% of the currently remaining West Coast Renosterveld (including Swartland Shale, Swartland Silcrete, Swartland Granite, Swartland Alluvium and Peninsula Shale Renosterveld). However, about 20% of these edges constitute borders to other natural vegetation types and therefore are likely to respond in a less drastic way than the edges to transformed vegetation such as in our study.

In contrast, Hester and Hobbs (1992) found no clear response to edges for any species in shrublands of the Western Australian wheatbelt and Kemper *et al.* (1999) detected no effect of fragment size of on species richness in Renosterveld on the South Coast of South Africa, even though they were including fragments ranging from 0.06-153 ha. The discrepancies between our study and Kemper's results (1999) can possibly be explained as follows: common, but non-edge-sensitive species mask edge effects in multivariate analyses, and the grouping of dicotyledonous and monocotyledonous geophytes into one group clouds the various patterns within that group; in our study we found that the common and abundant *Oxalis* species (Dicotyledons) were unresponsive to edges. Also, a small number of petaloid monocotyledonous species were common at the edge (*e.g. Moraea flaccida* Sweet and *Ornithogalum thyrsoides* Jacq., A.H., unpublished data), which would further mask any gradient effects on the abundance of geophytes in general.

The extent of the edge effect on petaloid monocotyledons found in our study was much greater than reported in most other studies on plants (Ries *et al.* 2004). This indicates that edge effects were unlikely to be caused by abiotic factors alone (Harrison & Bruna 1999). For the effect to be this clear on long-lived petaloid monocotyledons (life span up to several decades for large bulbs, J. Manning, SANBI, personal communication) it is likely that the plants were suffering from increased mortality near the edges. Porcupines are known to feed on bulbs (Bragg *et al.* 2005; Skinner & Smithers 1990) and thus are a potential factor in this context. They are known not to be deterred by transformed habitat or disturbance (personal communication with various farmers and personal observation) although they favor undisturbed habitats (Bragg *et al.* 2005). Other potential culprits include small mammals, such as mole rats (Reichman & Jarvis 1989) as well as invertebrates such as *Brachycerus* weevils (Procheş *et al.* 2006). It is also possible that the above-ground parts of the plants were subject to herbivory, but no obvious grazing damage was noted during the course of this study or is generally known to be common (J. Manning, SANBI, personal communication).

Edge effects could also be acting on plant reproduction. For instance, Donaldson *et al.* (2002) demonstrated that pollination rates in four petaloid monocotyledonous species in Renosterveld decreased with fragment size. Also, Argentine ants can invade as far as 200 m into natural habitat (Bolger 2007; Suarez *et al.* 1998) and consume up to 42% of available nectar before pollinating insects can forage (Buys 1987). They are common in Renosterveld and have been reported to have an effect on invertebrate species composition in the Cape (Christian 2001; Lach 2007; Picker & Samways 1996; Visser *et al.* 1996). It is therefore possible that there are edge effects on pollinator-plant interactions. However, asexual reproduction is common in some species and could buffer this effect (Pauw 2004; Pauw *et al.* 2004).

Edge effects on seed predation are highly species-specific and dependent on habitat preferences of local seed predators (Holl & Lulow 1997; Jules & Rathcke 1999; Ostfeld *et al.* 1997; Santos & Telleria 1994), but small mammals from the matrix habitat can harvest seeds up to 200 to 500 m into a fragment (Laurance 1994), so an effect on seeds of petaloid monocotyledons (or other species) up to this distance is possible.

Edge effects on germination and plant establishment have equally complex, species-specific results (Cadenasso & Pickett 2000; López-Barrera *et al.* 2005; Meiners *et al.* 2002). Competition with alien grasses, which are more common within 20 to 40 m of the edge (see also De Villiers *et al.* 2003; P. Holmes, personal communication), was shown to reduce establishment rates and decrease productivity in a number of Renosterveld species (Midoko-Ipongo *et al.* 2005; Muhl 2008). Furthermore, Vlok (1988) showed strong negative effects on general species richness of herbaceous species as well as geophytes and their abundance in lowland Fynbos and Renosterveld habitats. Since alien grass invasion only reaches less than 60 m into the fragments, this could only partially explain the extensive edge effects on petaloid monocotyledons.

Finally, ploughing can be a major factor influencing petaloid monocotyledon occurrences (Galil 1970; Hammouda *et al.* 2003). Edges in the study area have not been stationary since farming started in the area about 300 years ago and Talbot (1947) describes slopes of 14° and steeper being ploughed in the 1930s and 40s with the Tygerberg being mentioned as an example specifically affected by this. For formerly ploughed areas geophyte numbers could be reduced, as old-field succession has been reported to be particularly slow for geophytes (Krug & Krug 2007; Shiponeni 2003; Walton 2006).

Implications

From the results of our study and comparisons with other studies, we had to conclude that edge sensitivity cannot be easily inferred from other similar vegetation types or from one taxon to another. Edge response needs to be determined individually for each vegetation type or target species.

Considering our small sample size and exclusion of potentially relevant factors such as soil types, our study should be interpreted as a first but important step towards the determination of minimum patch sizes and effective corridor widths for the sustainable conservation of critically endangered Swartland Shale Renosterveld. Based on our results, we believe that smaller Renosterveld patches would benefit from being enlarged to a minimum width of over 400 m (ideally at least 800 m) to provide core habitat for the conservation of the species rich petaloid monocotyledons. For corridors and stepping stones we recommend a minimum width of over 60 m (ideally at least 120 m) to include a zone where edge species and alien grasses are not dominant. However, in agreement with Pressey *et al.* (1994, 1996) and Piessens *et al.* (2006), we must stress that even smaller patches can be important and worthy of conservation since core species do also currently occur there, albeit in lower numbers. Moreover, some unique micro-habitats with associated endemic species occur on small fragments only (Custodians of Rare and Endangered Wildflowers, South African Biodiversity Institute, unpublished data).

Further studies are essential and should include other taxa and a larger number of fragments to understand the effect of edges on the whole ecosystem and increase sample size for statistical validity. Ideally, fragments over 800 m in width should be studied to determine maximum edge effect extents, but since appropriate potential study sites of Swartland Shale Renosterveld are few and far between, this would most probably mean expanding into other types of Renosterveld. Finally, for conservation practitioners to effectively manage the ecological processes that cause edge effects, these processes first need to be identified and understood for the target system or taxon. We therefore want to emphasize the urgency of conducting detailed studies on the impacts of edge-driven pollination, dispersal and establishment limitations and especially the effects of herbivory in Renosterveld (see also Kongor 2009).

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Appendix 1 – List of woody species and their average cover in cm per 10 m transect at each distance from the edge of the fragment with species distribution area and endemism status.

species name	Distribution	Distance from the edge in meters							
		1	2	5	10	20	50	100	200
Anthospermum aethiopicum L.	SW to S Coast of South Africa	6	14	18	15	12	28	65	70
Aspalathus ericifolia L.	SW Coast, **Endemic** to CFR*	3	4	0	1	0	7	2	0
Asparagus capensis L.	Southern Namibia and South Africa	1	0	0	2	0	2	7	23
Asparagus lignosus Burm.f.	**Endemic** to the CFR	0	0	0	0	1	0	0	2
Asparagus rubicundus P.J.Bergius	SW South Africa	0	0	0	0	0	0	0	2
Athanasia trifurcata (L.) L.	**Endemic** to the CFR	83	64	59	5	12	3	1	0
Berkheya rigida (Thunb.) Adamson & T.M. Salter	**Endemic** to the CFR, often in disturbed areas	21	7	8	5	0	0	2	0
Chironia baccifera L.	South Africa	2	4	6	11	23	8	28	16
Chrysanthemoides incana (Burm.f.) Norl.	Namibia and South Africa	0	0	0	0	6	0	0	3
Chrysocoma ciliata L.	South Africa	4	5	8	9	8	4	7	2
Cissampelos capensis L.f.	Southern Namibia and South Africa	0	0	9	7	0	21	42	47
Clutia ericoides Thunb.	W to S Coast of South Africa	0	0	0	0	1	10	25	2
Cyphia digitata (Thunb.) Willd.	W to S Coast of South Africa	1	1	3	19	4	4	5	0
Dicerothamnus rhinocerotis (L.f.) Koek.	= renosterbos, Southern Namibia and South Africa	214	203	252	249	207	255	211	259
Eriocephalus africanus L.	Coastal areas of South Africa	232	216	316	377	335	349	260	253
Euphorbia arceuthobioides Boiss.	Namibia and South Africa	0	0	0	0	14	8	0	0
Euryops thunbergii B.Nord.	**Endemic** to the CFR	0	0	0	0	4	58	42	23
Felicia fruticosa (L.) G.Nichols.	South Africa	29	32	29	53	94	89	81	39
Galenia africana L.	W to SW South Africa	55	41	16	7	24	62	36	10
Helichrysum patulum (L.) D.Don	**Endemic** to the CFR	17	12	28	23	23	8	4	36
Helichrysum revolutum (Thunb.) Less.	Southern Namibia to SW South Africa	21	67	78	108	189	154	169	71
Leysera gnaphalodes (L.) L.	Southern Nambia and South Africa	16	24	7	2	1	0	6	0
Lycium afrum L.	**Endemic** to the CFR	0	1	0	2	1	0	4	0
Lycium ferocissimum Miers	Coastal areas of South Africa	0	2	5	0	0	1	0	0
Melianthus major L.	Coastal areas of South Africa	0	0	0	1	0	0	0	0
Microloma sagittatum (L.) R.Br.	W to S Coast of South Africa	1	0	0	0	0	0	0	0
Muraltia heisteria (L.) DC.	**Endemic** to the CFR	19	12	7	4	4	5	13	0
Olea capensis (Jacq.) Klotzsch	South Africa to tropical Africa	0	0	0	0	0	0	0	1
Otholobium hirtum (L.) C.H.Stirt	Renosterveld, **Endemic** to the CFR	55	35	10	5	6	11	0	1
Polygala garcinii DC.	**Endemic** to the CFR	0	0	0	1	0	0	0	0
Pteronia divaricata (P.J.Bergius) Less.	Southern Namibia to Tygerberg Hills	2	19	40	23	36	10	12	33
Putterlickia pyracantha (L.) Szyszyl.	W to S Coast of South Africa	0	0	0	0	0	2	0	7
Rhus dissecta Thunb.	**Endemic** to the CFR	0	0	0	0	0	0	0	4
Rhus glauca Thunb.	W to S Coast of South Africa	0	0	0	0	27	0	8	52
Rhus laevigata Thunb. var. *laevigata*	W to SW Coast of South Africa	0	0	10	12	24	1	0	0
Rhus laevigata var. *villosa* (L.f.) R.Fernandes	W to SW Coast of South Africa	0	0	11	0	3	0	0	0
Salvia africana-lutea L.	W to SW Coast of South Africa	0	0	8	0	0	3	0	3
Solanum guienense L.	W to SW Coast of South Africa	0	0	10	42	9	13	0	9
Tetragonia fruticosa L.	W to SW Coast of South Africa	5	15	2	6	14	6	8	28
*CFR = Cape Floristic Region									

***Appendix 2** – List of dicotyledonous herbaceous species with number of line transects they occurred on (with a maximum of 30) at each distance from the edge of the fragment and species distribution area and endemism status.*

species name	Distribution	Distance from the edge in meters							
		1	2	5	10	20	50	100	200
Anagallis arvensis L.	Exotic			3	2	4	8	5	6
Arctopus monocanthus Carmicheal ex. Sond.	**Endemic** to the CFR								1
Arctotis hirsuta (Harv.) Beauv.	**Endemic** to the CFR			1	2	1			2
Avena sativa L.	Exotic			1			3	1	1
Cheilanthes capensis (Thunb.) Sw.	Southern Africa							4	3
Cotula bipinnata Thunb.	West Coast of South Africa	1		1		1			
Cotula turbinata (L.) Pers.	**Endemic** to the CFR, often in disturbed areas						1	1	
Crassula capensis (L.) Baill.	**Endemic** to the CFR							1	1
Diascia diffusa (Thunb.) Benth.	Renosterveld, **endemic** to CFR								1
Dimorphotheca pluvialis (L.) Moench	Southern Namibia to the SW South Africa	5	2	3	1		1	3	4
Erodium moschatum (L.) L'Hér.	Exotic	2	1	1	1		1	2	2
Euphorbia mauritanica L.	Southern Africa								1
Felicia tenella (L.) Nees	**Endemic** to the CFR						3	4	6
Fumaria muralis Sond. ex Koch	Exotic				1	2	1	3	3
Hemimeris sabulosa L.f.	W to SW Coast of South Africa	1	1	3	1	2	1	2	5
Indigofera heterophylla Thunb.	Renosterveld, Coastal areas of South Africa	2	1		3	1	2	2	
Medicago polymorpha L.	Exotic						1	1	1
Mohria cafforum (l.) Desv.	Renosterveld, Western to Eastern Cape of South Africa		2	3	7	13	11	14	17
Nemesia barbata (Thunb.) Benth.	W to SW Coast of South Africa			1	1		1	1	2
Oxalis argyrophylla T.M. Salter	**Endemic** to the CFR			1					
Oxalis obtusa Jacq.	W to SW Coast of South Africa	3	1		3	4	5	3	5
Oxalis pes-caprae L.	Coastal areas of South Africa	27	25	28	28	27	30	27	24
Oxalis purpurea L.	W to SW Coast of South Africa	7	5	5	6	5	7	4	6
Oxalis tomentosa L.f.	**Endemic** to the CFR				2	1	1		2
Spergularia media (L.) C.Presl	Exotic			1		1	1	4	2
Stachys aethiopica L.	South Africa								2
Tripteris clandestina Less.	W to SW Coast of South Africa			2				2	1
Ursinia nana D.C.	Coastal areas of South Africa							2	3

Appendix 3 – List of petaloid monocotyledonous species with number of line transects they occurred on (with a maximum of 30) at each distance from the edge of the fragment and species distribution area and endemism status.

Species name	Distribution	Distance from the edge in meters							
		1	2	5	10	20	50	100	200
Albuca canadensis (L.) F.M.Leight.	West Coast of South Africa								1
Babiana odarata L.Bolus	**Endemic** to renosterveld, SW coast of the CFR								2
Hesperantha falcata (L.f.) Ker Gawl.	**Endemic** to renosterveld, CFR						1		2
Lachenalia unifolia Jacq.	West Coast of South Africa, locally frequent					1			1
Melaspherula ramosa (L.) N.E.Br.	Coastal areas from Southern Namibia to the Eastern Cape of South Africa, locally frequent			1	1				1
Moraea ciliata (L.f.) Ker Gawl.	Western Cape of South Africa and adjacent areas					1			
Moraea flaccida Sweet	**Endemic** to CFR, locally frequent	2						2	
Moraea gawleri Spreng.	South Western Coast of South Africa, frequent					1		2	
Moraea tripetala (L.f.) Kew Gawl.	Western Cape of South Africa and adjacent areas, frequent								1
Ornithogalum thyrsoides Jacq.	Western Cape and adjacent areas, frequent	1							
Pterygodium catholicum (L.) Sw.	**Endemic** to renosterveld, CFR, frequent after fire	2	1	2	3	1	2	5	4
Sparaxis villosa (Burm.f.) Goldblatt	**Endemic** to the West Coast, CFR			1	1		2	2	3
Spiloxene capensis (L.) Garside	**Endemic** to the coastal areas of the CFR, locally frequent								1
Spiloxene serrata (Thunb.) Garside	West Coast of South Africa				1		1	3	3
Trachyandra muricata (L.f.) Kunth	Southern Namibia to SW Cape of South Africa								1
Tulbaghia capensis L.	**Endemic** to the coastal areas of the CFR, locally frequent								2

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